THE DENTAL PRACTITIONER

AND DENTAL RECORD

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Glasgow Odontological Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. VIII, No. 4 December, 1957

EDITORIAL

HIGH-SPEED INSTRUMENTS

One of the greatest discomforts in dentistry is the operation which involves the cutting of the tooth substance in the course of cavity preparation. Noise, vibration, and heat production all form part of a process which the average patient dislikes intensely. Practically every patient is to a certain degree apprehensive of this stage in treatment of the teeth, and any method that tends to reduce this unpleasantness is a blessing to patient and operator. An article by G. A. Lammie in this issue discusses this aspect of dentistry and the developments that have been made in recent years. The technical difficulties of designing a handpiece and tool to cut dental tissues of varying hardness are very great, and years of research have been spent on the problem. With the introduction of very high-speed cutting instruments, it looks as if we are entering a new phase of dentistry. The standard dental engine producing 2000–3000 r.p.m. is undoubtedly an inefficient instrument if it is required to cut both hard enamel and soft dentine. It would appear that the specific problems encountered in designing a dental cutting instrument make it inevitable that two different types of instrument may have to be used. The very high-speed machines are excellent for general cavity preparation, but there will always be a definite place for a low-speed instrument. The new air turbine handpiece, for example, used with a diamond bur, gives a speed of 150,000—200,000 r.p.m. and is a neat compact instrument. It is used with the lightest of touch as any undue pressure will reduce the speed considerably. Normal working speed is probably between 60,000 and 90,000 r.p.m. This lack of any pressure on the tooth will reduce the vibration and bone conduction of noise, and as it is combined with a water spray the heat production is minimal. With the development of high-speed electric engines, air-abrasive techniques, ultrasonic apparatus, and now the air or water turbine handpiece, the profession can be safely assured that a tremendous amount of back-room work has been carried out for the benefit of themselves and their patients.

The Editor and Publishers
wish all readers of
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a Happy Christmas and a
Prosperous New Year

ADVANCES IN THE CUTTING OF HARD DENTAL TISSUES

By G. A. LAMMIE, Ph.D.

In the last decade great strides have been made in the cutting of teeth in operative dentistry. Progress has been made as a result of laboratory investigation and by applying methods used in different branches of industry. Certainly the part played by dental manufacturers in pioneering new approaches to the problem must be recognized. As in so many challenges of dentistry, mechanical and biological requirements must be met and the demand becomes very exacting.

THE MECHANICAL REQUIREMENT

Three distinct types of dental tissue must be removed in almost every cavity preparation; these are enamel, dentine, and altered dentine, this last term referring to dentine which has been partially or completely decalcified by carious attack. Enamel, especially when supported by sound dentine has a high resistance to cutting, the significant physical property being not its hardness but its high abrasion resistance. Day-to-day experience tells us that there is a wide variation in the "drillability" of the enamel of different teeth either in the same mouth, or in different mouths. An adequate cutting method must be capable of removing the most resistant enamel in an acceptable time period. In contradistinction dentine is generally easily removed and does not make an exacting demand on the cutting method. It is, however, not sufficiently appreciated that altered dentine does; especially when this has a tough fibrous character as seen in a slow carious process it can present a problem. Some recently introduced methods, in fact, cannot be used for the removal of this pathological tissue. Moreover, since the modern tendency is towards conservation of sound dentine, it is desirable that the cutting method should, by its very nature, be capable of removing the altered dentine but leaving the sound dentine intact; it is suggested that the precise conditions of cutting rather than a high degree of skill on the part of the operator, should be the critical factors in this "discriminative cut".

THE BIOLOGICAL REQUIREMENT

Even more important than the mechanical is the biological demand. The patient must be safeguarded against pain and vibratory effects.

Pain may be experienced by the patient during or subsequent to cutting. It is probable, although by no means proven, that both types of pain are caused by heating.

Freedom from pain during cavity preparation is assured by a combination of several approaches, the careful operator relying on all, rather than one, of the methods. First, the approach of the surgeon is important since a manner which invites confidence rather than induces fear reduces the pain threshold of the patient; a subliminal pain stimulus in a relaxed patient could well produce severe pain in one who was afraid. Secondly, the use of drugs affords a recommended, if symptomatic, aid. Both general analgesics and local anæsthetics come into this category. There can be little doubt that the advent of xylocaine (Thexton, Wishart, and Baxendine, 1950) has done much to ensure painless cavity preparation even in the most sensitive patients. Thirdly, efficient cutting plays a very important part in ensuring a painless operation. This infers a low input of energy to obtain maximal comminution of tooth substance; since a large proportion of the expended energy is converted from kinetic into heat (Bond and Wang, 1950) an efficient cutting process assures that minimal heat is produced. The two most important factors presently known which contribute to efficient cutting are, preservation of the cutting edge during function and adequate arrangement for removal of the cut particles from the immediate site of cutting. Fourthly, it must be obvious that intermittent rather than prolonged cutting will limit the temperature rise; this approach has certain limitations, especially with tungsten-

carbide fissure burs used at conventional speeds, where the first application of the bur is fraught with increased hazards of fracture or edge chipping (Lammie and Draycott, 1952). Fifthly, the use of some system of cooling must now be considered an operative essential. In some methods air cooling is preferred; certainly this is inferior to cooling with water and entails the added risk of dehydrating the dentine. Some method of water cooling must be considered the approach of choice. By the routine use of all these methods it is now possible to assure practically every patient that he will not "feel the drill".

The pathological appearances which follow cavity preparation and which account for after-pain have recently been well described by Marsland and Shovelton (1957). Resolution of the inflammatory process in the pulp generally appears to ensue and this accounts for the fact that after-pain generally ceases after a period varying from a day to two weeks. In severe cases the after-pain may be continuous and increasing in severity, due to abscess formation and necessitating extraction of the tooth. Efficient cutting and thorough cooling are found to go a long way to eliminate after-pain. However, even with the most thorough precautions a few patients develop pain lasting less than a day after cavity preparation; in such cases symptomatic treatment with analgesic drugs has always been found sufficient.

The patient must also be guarded against vibratory effects. In particular, one of the most distressing features of rotary cutting is the objectionable bone-conducted auditory sensation; in some patients this is feared more than pain. The sensation is experienced more when cutting is carried out in the upper than the lower jaw, the intermediary soft tissues of the joint having a dampening effect in the latter case. The effect is most noted when upper molars are being prepared; here the anatomical proximity of the internal ear, and the direct and intact bony connexion of the two should be noted. Vibrations perceived by the patient stem from the belt, engine and pulleys, handpiece, and cutting instrument when rotary cutting is used (Peyton, 1955). However, the most disturbing vibrations arise through the impact of the cutting instrument with the tooth and these have both amplitude and frequency; the first is intimately associated with the force of impact of the cutting edge and the latter with the speed at which one impact follows the other. Light impact force and high speed of successive impacts are desirable criteria to minimize this distressing auditory sensation; ideally the frequency of the vibratory movement should be above the level of sonic perception. Although this auditory sensation is the most apparent and distressing complication in this class it must not be assumed it is necessarily the only result of the vibrations incurred in cutting. Whether or not these have an effect on the pulps of the teeth, the bone, brain cells, or other tissues is not capable of accurate assessment at the present time.

AN ASSESSMENT OF THE VARIOUS CUTTING METHODS

The present cutting methods may be classified into rotary, percussive, and projected particle. A great deal of the developmental work with the equipment used in these methods has been done by American manufacturers, and their products are not yet available in this country. An assessment of these will be given based on the writer's experience in using them while recently working in America.

ROTARY CUTTING

In the first place remarks on rotary cutting will apply to speeds currently used in this country, i.e., speeds up to 6000 r.p.m.

Instruments used in dentistry for rotary cutting may be classed as cutting or abrasive. The first class comprises the burs and the second diamond instruments and carborundum stones. These groups are differentiated by the size of the chips removed during the cutting operation; the chip removed by a cutting instrument is larger than that taken by an abrasive tool. There is, however, no precise chip size differentiating the two, and the actual size of the chip removed depends on the nature of the material being cut as well as the conditions of rotational speed and applied torque under which the instrument works.

Advantages may be cited for each type of instrument and each has its different application.

Since the degree of comminution effected by a bur is smaller than that obtained with an abrasive instrument, on theoretical grounds more efficient cutting should be obtained and accordingly less heat generated. Certainly this would be true if the bur edge and abrasive particles were made of the same material. Where the material is readily cut as in the case of dentine, a cutting instrument is to be preferred to an abrasive on the grounds of efficiency. When, however, enamel is to be cut the abrasive instruments permit the use of diamond, the physical properties of which commend it more than those of tungsten carbide for edge preservation during cutting, and this factor must offset the consideration of chip size. The bur has the additional advantage that in its design, allowance can be made for chip clearance much more readily than with abrasive instruments. Further, as more knowledge is gained of the physics of comminution, in the bur it will be possible to place the cutting edges in such relationship to each other as to give most efficient action. The mechanical problem of grinding these edges on such a small area as the cutting head of a dental bur is becoming a simpler matter than formerly, and it may well be possible in the future to produce a bur with a larger number of edges than the present six on a tungsten carbide bur.

Both steel and tungsten carbide burs are available to the dentist. The first may well be used when dentine or altered dentine are to be cut. In certain situations the very small sizes in which they are available make them preferable to tungsten carbide. It cannot be too strongly emphasized, however, that a steel bur should not now be used on intact enamel (Lammie and Draycott, 1952); its edge becomes very quickly deformed and in this condition is much less effective in cutting further enamel. Of graver consequence such a mutilated edge will not cut dentine efficiently and may well generate sufficient heat to cause a pulpitis.

One of the great uses of a bur commonly applied, but seldom appreciated or described, is in the "discriminative cut". A large round bur, often made of steel used under conditions of slow speed (below 1000 r.p.m.) and light pressure, effects a selective removal of carious dentine and leaves the unaltered dentine. Patent dentinal tubules are therefore not opened up and small amounts of secondary dentine may be preserved with facility.

Abrasive instruments are made of diamond and carborundum. Because of the superior cutting characteristics of diamond and the progress which has been made in bonding the particles to the formed blank, carborundum stones are now only used as finishing instruments.

One of the great advantages of abrasive instruments over burs is that the bone-conducted auditory sensation is less distressing because of the more frequent application of the cutting edges under less pressure. On the score of cutting efficiency diamond instruments certainly remove sound enamel effectively. However, on dentine the abrasive action is accompanied by more heat liberation than with a tungsten carbide bur. Accordingly it is wise to use diamond instruments only with some water-cooling device.

It is now a considerable time since Walsh and Symmons (1948) reported on the advantages of the use of high rotational speeds in operative dentistry. Many instruments have now been designed and produced incorporating this principle, and, particularly in America, high-speed cutting is being widely acclaimed. Three different types of instrument have been used and each will be discussed:—

1. The air turbine.
2. The water turbine.
3. The modified dental engine.

1 and 2. The Turbines.—Since the air and water turbines have many features in common it is pertinent, in the first place to consider them together. In the form both have been used in dentistry they are simple and relatively inexpensive. Further, their design is such that relatively little servicing is required and durability is characteristic. Both instruments give high rotary speeds in the region of 50,000 r.p.m. with a very small torque value. Some authorities emphasize that this

constitutes a desirable property since if the handpiece slips the rotating tool almost immediately stops when it comes in contact either with the rubber dam or soft tissues of the mouth; in this way traumatic complications are avoided. On the other hand a low torque value means that even when the cutting instrument is applied to the tooth with the advocated "feather-light" touch a continuous reduction in rotary speed ensues. To overcome this an intermittent, stroking, cutting technique is used, and when mastered, the rate of removal of enamel is good. Abrasive instruments rather than burs are indicated because of a low torque. Both of the turbines find their most serious disadvantage in the fact that there is no simple manual control of speed; in neither is it possible to obtain a continuous slow rotational speed and accordingly their only advantage lies in the cutting of intact enamel. Either altered or unaltered dentine is better cut by conventional rotary methods.

As well as having advantages and disadvantages common to the class, air and water turbines have individual characteristics. The use of the air turbine is associated with a constant whining sound which is generally perturbing to the patient. Different sizes of diaphragm aperture may be used to secure different initial rotary speeds but the changing of these involves considerable time and mechanical effort. Generally, too, the instrument size is large, giving rise to operative difficulties in children and at the back of the mouth. Cooling may be effected by the air-jet or by the use of water (Stephens, 1956). The use of an air turbine instrument of course requires a compressed-air supply of sufficient volume displacement per minute.

The water turbine (Nelsen, Pelander, and Kumpula, 1953) is superior to the air turbine both in its noiseless performance and its associated water cooling. The handpiece size, too, in the instrument designed by Nelsen at the Bureau of Standards, Washington, D.C., compares favourably with that seen in all other classes of instrument. Some difficulty was, however, initially experienced with the water seals; it is believed that this mechanical difficulty has been overcome by the use of nylon seals which require to be changed regularly.

3. The Modified Dental Engine.—Increased rotary speeds using the conventional type of dental engine have been achieved by the development of electric motors capable of increased speeds and of a specially designed handpiece which effects a further increase in the applied rotary speed through an incorporated gearing. The first may be used independently when speeds of the order of 30,000 r.p.m. may be obtained. However, when such an engine is used in conjunction with the Chayes handpiece, speeds stroboscoped at over 180,000 r.p.m. have been obtained.

The Chayes handpiece, although somewhat longer than the conventional handpiece, has a terminal head which compares favourably in size and facilitates operation where space is restricted. The drive through the handpiece is effected by means of a nylon belt and lubrication is by grease packing. The collet which secures the cutting instrument merely consists of a rubber sleeve with an embedded metal spiral spring. The effect of rotation is to decrease the diameter of the collet and firmly retain the tool. The handpiece is returned to the manufacturer for servicing every few months and generally a dentist has two handpieces to ensure continuous availability. The handpiece incorporates an essential water-cooling device.

As presently developed the combination of the high-speed engine and the Chayes handpiece seems to give a good solution to the cutting problem. By interchanging a conventional handpiece the desirable slower range of speeds may be obtained with the one instrument; thus the mechanical and biological demands of the operator are met with restricted armamentarium. The torque developed by the instrument is greater than that produced by the turbines; accordingly there is less decrease of speed in use. Some would consider that this constitutes a hazard to the soft tissues if slippage occurs. However, with careful operation, there is little, if any, tendency for slip to occur with the light load used in applying the cutting tool. Both burs and diamond abrasives

have been developed for use with the handpiece, and with both the perceived vibratory effect is minimal. It is claimed that more efficient cutting is obtained, and with light application increased rate of removal of enamel is noted. One outstanding feature of the method is that tungsten carbide burs are preserved better than when conventional speeds are used. Certainly discrete edge-chipping and fracture of the corners of fissure and inverted cone burs is not noted; this is doubtless due to the reduced impact load on the edges of the bur.

PERCUSSIVE CUTTING

Percussive cutting is at present widely used in rock drilling, a cutting tool making a vertical impact on to the rock surface and then effecting a rotation through a small radial angle. The type of percussive drilling introduced into dentistry differs basically from this widely accepted form in mining. First, the cutting medium is not a tool but an intermediate abrasive paste. Secondly, there is only a vertical movement of the cutting piece unaccompanied by any rotary movement.

The ultrasonic equipment used for cutting teeth may be divided into the electronic unit, the pumping mechanism for the abrasive slurry, and the handpiece assembly; it comprises a rather large piece of equipment (Neilsen, Richards, and Walcott, 1955).

The electronic unit is complex and doubtless accounts in large measure for the high cost of the equipment. The pumping mechanism is energized by an electric motor which drives the abrasive "slurry" from a storage tank to the handpiece. This last component is larger than any of the handpieces in the other instruments described. It carries at its extremity one of a large selection of differently shaped cutting pieces, which must be firmly secured by the use of a spanner. Separate small diameter leads to the handpiece carry the slurry and water. Cutting is effected by a low amplitude high-frequency oscillation of the cutting piece on to the abrasive mixture, a suspension of abrasive particles in water, the water-jet being used to clear the field rather than effect a cooling action.

The great advantage of the method is its complete absence of bone-conducted auditory effects. However, to offset this there are a great many disadvantages in the instrument as it is presently designed:—

1. Vision of the part being cut is obscured by the covering layer of abrasive slurry. To examine the results of the cut the field must be cleaned by using the water-jet.
2. Cutting of carious dentine is not effected and thus an engine is required additionally.
3. Changing the cutting heads takes considerable time.
4. Wear of the cutting heads takes place.
5. The rate of removal of enamel is variable.

It was suggested that one of the fields in which a bulk of research was needed was in pulp reaction to cavity preparation. Especially when very high rotary speeds and ultrasonic vibration are used is this required. As well as the heat factor the high-frequency low-amplitude vibrations may themselves cause some reaction in the pulp or more remote tissues. When it is considered that the vital biochemical reactions in a cell are catalysed by high molecular weight proteins arranged in web-like manner to secure maximal intra-cellular interfaces, and with the knowledge that such vibrations may cause coagulation, then it becomes wise to inquire into the actual nature of the reaction, if any, which takes place. Experiments conducted on animals, especially those much smaller than man with continuously erupting teeth, do not give any information on human reaction. Further it is not valid to reason from medical experience where ultrasonic vibrations of higher frequency and lower amplitude have caused bone necrosis. Most recent observations indicate that "the pulp is remarkably resistant, rather than being a delicate organ" (Robinson, 1957). Moreover, the reporting of clinical data covering short and long time periods in a large number of cases must also be considered invaluable.

PROJECTED PARTICLE CUTTING

The Airbrasive equipment developed by Black (1945, 1955) and manufactured by the S.S. White Company is the only instrument

available in this class. Cutting is effected by the sharp edges of abrasive particles which are projected in a stream of gas against the tooth surface to be cut. The kinetic energy of the particle thus effects the comminution. With this instrument the absence of vibratory perception is a great advantage; cooling is effected by the gas stream.

A considerable number of disadvantages have prevented this technique from becoming popular. The method of use is very different from that of rotary cutting, and a new technique must be learned by the operator. The acquiring of new muscular skills as learned patterns takes a considerable time, and all the longer in older practitioners. Further, the aid of a palpatory sensation is absent, and accordingly more comes to depend on the visual. Even when a cavity is well lit it is often very difficult to see angles well. This is only one reason for the inability to cut precisely with the instrument and the consequent need for fine cutting to be done with abrasives or burs in the dental engine; the spread of the abrasive particles is another reason for this. As with ultrasonic cutting the method is inadequate when carious dentine has to be removed and other supplementary methods must be employed; since this need is found in almost all preparations, it becomes a severe drawback to the technique. Rubber dam must always be used with the Airbrasive, and thus more chair-side time is required. The operation of the unit is accompanied by considerable noise which is unpleasant to both patient and dentist. Additional disadvantages are the high cost and large size of the equipment and the need for special abrasion-resistant dental mirrors.

WATER COOLING

The use of water when cutting tooth substance has gained considerably in popularity since its benefits have come to be appreciated and good equipment has been developed. Undoubtedly the cooling action is the paramount advantage of cutting under water. As well as conducting the heat formed away from the cutting edges, the water also effectively removes the chip and thus reduces frictional effects. It also ensures that the cavity is always clean and can readily be inspected. Dehydration of the dentine is also impossible.

Two types of water stream have been used for cooling. First there is an air stream with water globules in dispersed form; this type of stream is given by the Hanau Thermex Spray and other similar units. Various air–water ratios may be used, the extreme case being the second possibility of a non-atomized water stream. The latter ensures more effective cooling action because of the greater heat capacity of the larger volume of water. It does, however, emphasize the problem of effectively removing the water. The use of a unit which is automatically controlled by the foot pedal of the engine reduces the amount of water used and eliminates the need for either patient or nurse co-operation (Lawton and Myers, 1947).

One piece of equipment, the Vacudent, has been designed to effectively remove large volumes of water from the mouth when water cooling is used. It consists of an electrically driven vacuum pump effecting a large volume air-displacement. A wide-bore tube conducts the water–saliva mixture to a receiver which is emptied after use. Two types of mouthpiece are used; the first being a metal tube which is held and operated by the chair-side assistant. It is more effective than the alternative rubber loop mouthpiece which is accommodated in the vestibular sulcus; this second type dispenses with the need for an assistant. Effective removal of the cooling stream of water does a great deal to make the patient's experience undisturbed, and there is no embarrassment over a filling mouth and inability to swallow. In addition the Vacudent equipment goes a long way to avoid splattering of the dental mirror, a serious drawback when a maxillary tooth is being cut.

SUMMARY

1. The mechanical and biological requirements of cutting are outlined.

2. Rotary, percussive, and projected particle methods of cutting are described and assessed.

3. The advantage of water cooling is stressed.

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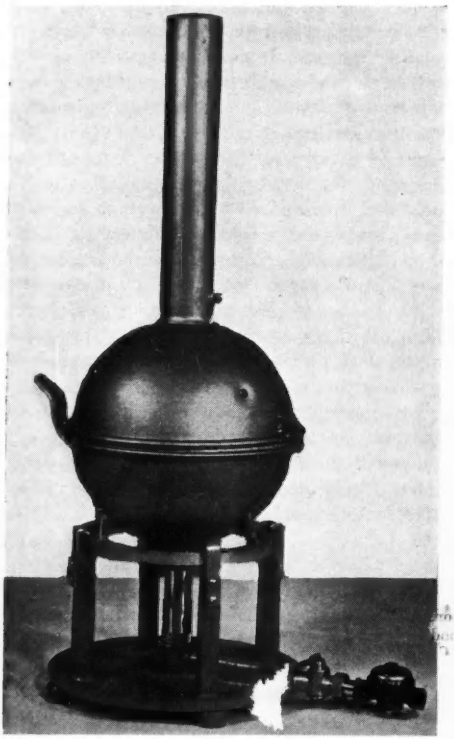
NEW MATERIALS AND APPLIANCES

DENTAL FURNACE

A NEW dental furnace has been developed by the Gas Council. It is described in a recent report of the Industrial Gas Development Committee. Briefly, the apparatus consists of a sillimanite-lined spherical mild-steel chamber in two halves on a cast aluminium stand with an incorporated gas-duct. The maximum temperature produced is 790° C. This apparatus appears to be a distinct improvement in design and efficiency over existing furnaces available. (Reproduced from report No. 636/57 of the Industrial Gas Development Committee of the Gas Council. (Information supplied by the North Thames Gas Board. Manufacturers: Nesor Products Ltd., 3, Caledonian Rd., London, N.1.))



FACIAL FIBROUS DYSPLASIA

A REPORT OF TWO CASES

By H. P. COOK, M.B., B.S., B.D.S., F.D.S. R.C.S.
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THE term facial fibrous dysplasia is now recognized as descriptive of a definite clinical entity with individual characteristics. The literature on the subject is confusing on account of the numerous terms used without agreement as to what they mean. Focal osteitis fibrosa, monostotic fibrous dysplasia, fibrous osteoma, and ossifying fibroma have all been used without discrimination. The position has recently been made much clearer in papers by Rushton (1950) and Cooke (1957), both of whom have given careful and precise descriptions of the condition.

Lack of agreement on the aetiology of the condition has also contributed to the clinical confusion. The concept of facial fibrous dysplasia as a benign neoplasm, advocated by Phemister and Grimson (1937) and Scarff and Walker (1948), now seems unlikely. It is probable that the condition represents a developmental anomaly of the bone as suggested by Fisher (1948) and Rushton (1950). The most common occurrence of facial fibrous dysplasia in childhood and adolescence supports this view. Observation of these lesions shows that they do not slowly advance in growth as would be expected in the case of a benign neoplasm. In fact, activity gradually peters out and their development ceases concurrently with general growth after puberty. A state of arrest or equilibrium is therefore reached.

The two cases described here are recorded because they demonstrate well the features of the syndrome in its arrested stages. It should be noted that seventeen out of the twenty-two cases described by Cooke showed no advancement of growth over a period of years.

Some authors, Schlumberger (1946) and Geschicter and Copeland (1949), have suggested that fibrous dysplasia represented a response by bones to injury. The removal of bone and its replacement by fibrous tissue in which new bone was formed represented a repair process. The remarks were, however, of a general nature and not applied directly to the well-defined lesions found in the jaws.

When the maxilla is affected, the lesion is seen as a smooth, painless, bony swelling of the upper alveolus, extending from canine to molar region. The floor and lateral wall of the related antrum are usually also involved, and there is often obliteration of the antral cavity. A good description of a typical case is given by Davis (1941) in his paper.

The appearance of facial fibrous dysplasia as seen in dental radiographs is very characteristic. The bone trabeculæ are arranged in a very close pattern, which has appropriately been likened to "orange peel", and it is this appearance which suggests the arrested stage. (Glickman (1948), Rushton (1950), and Cooke (1957).)

Another point of interest seen in radiographs is the way in which the lesions are limited in spread by sutural division between articulating bones. Thoma (1954) is in disagreement with this view, stating that sutures are not respected in the facial bones by advancing disease. However, the phenomenon is well seen in the tomographs of *Case* 1 (*Fig.* 2), and has previously been commented on by Scarff and Walker (1948), Rushton (1950), and Cooke (1957).

It is usual in this condition for the serum values of calcium, phosphorus, and alkaline phosphatase to be within normal limits.

CASE REPORTS

Case 1.—The patient was an Indian male student, aged 25 years. He was symptomless, but had been referred by his own dentist on account of a swelling of the left maxillary alveolus. It was first noticed two months previously, and the patient was otherwise in good health.

ON EXAMINATION.—A hard, smooth lump was found arising from the buccal aspect of the left upper alveolus. This involved the whole structure from first premolar to second molar region so that it was expanded to form a sessile swelling. The lump was bony hard and

painless, and its covering mucous membrane was normal in colour and texture. The related teeth were normal and vital, and the regional lymph-nodes were unaffected.

The patient's blood was investigated, but the values returned for serum-calcium, phosphorus, and alkaline phosphatase were within normal limits.

portion of the alveolus showed bony expansion which merged with the antral deposit. The remainder of the calvarium, chest, and long bones were normal.

Tomographs (*Fig.* 2) defined the reduction in size of the left antral cavity and the position of the alveolar swelling. The position of the left zygomaticomaxillary

Fig. 1.—*Case* 1. Occipitomental view of skull showing density of left maxillary sinus.

Fig. 2.—*Case* 1. Tomograph showing near obliteration of left maxillary sinus by bone and left buccal alveolar swelling. Position of zygomaticomaxillary suture well seen.

Fig. 3.—*Case* 2. Dental radiograph showing orange-peel pattern of trabeculæ.

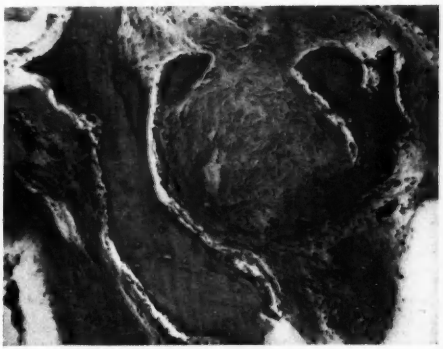

Fig. 4.—Photomicrograph of *Case* 2. H. and E. (× 75.)

Occipitomental radiograph of the skull (*Fig.* 1) showed well-marked sclerosis affecting the left maxillary bone. The antrum was partially obliterated by new bone formation on its floor and lateral wall. The buccal

suture was clearly visible, and demonstrated the sutural demarcation of normal from abnormal bone.

The dental film showed the orange-peel pattern. Biopsy was not considered necessary, and a clinical

diagnosis of facial fibrous dysplasia was made. No treatment was suggested other than periodic observation.

Case 2.—This patient was a female, aged 38 years, who worked as a draughtswoman. She had no symptoms and was also referred by her own dentist on account of a swelling of the upper right alveolus. This had been noticed by him three months previously, prior to which

Fig. 5.—Post-operative radiograph (*Case* 2) nine months after operation. Area healed with bone showing orange-peel pattern.

the patient was unaware of it. There was nothing of note in the medical history ; her general health was good.

On Examination.—A smooth, bony, hard swelling of the upper right buccal alveolus was disclosed. It was one-and-a-quarter inches long, extending from first premolar to second molar region, and was covered by normal mucous membrane. The appearance was of a smooth expansion of the bone which was difficult to define. The associated teeth were vital and the regional lymph-nodes impalpable.

A dental radiograph (*Fig.* 3) revealed the orange-peel pattern of the bone trabeculæ, which extended from canine to molar region.

Occipitomental view of the skull confirmed the bony expansion of the upper alveolus, which was continuous with slight thickening of the lateral wall and floor of the right antrum. There was no reduction in size of the antral cavity. Tomograph added little except to define the extent of the buccal swelling.

A diagnosis of facial fibrous dysplasia was made and a cosmetic trimming operation carried out to reduce the bulk of the swelling.

Histology (*Fig.* 4).—The bone trabeculæ were irregularly arranged and showed many resting and reversal lines. Interspaced with the bone were areas of well-formed fibrous tissue. There was little evidence of osteoblastic activity and no fatty marrow was seen. The appearances were suggestive of inactive facial fibrous dysplasia.

DISCUSSION

Both these cases show the history and clinical features of facial fibrous dysplasia. Neither patient was aware of anything abnormal until their attention was drawn to the lesion. The orange-peel radiographic pattern was present in both, and limitation of spread by suture is seen in one. A typical histological appearance was present in the other.

SUMMARY

Two cases of facial fibrous dysplasia are presented and their features described. The question of aetiology is briefly considered.

Addendum.—A dental radiograph was taken of the affected area in *Case* 2 nine months post-operatively. (*Fig.* 5.) It disclosed that the area had been repaired by bone which still showed the "orange-peel" pattern.

The abnormality had in no sense been removed. The propensity for laying down abnormal bone was evidently inherent in the tissue locally.

Acknowledgements.—My thanks are due to Mr. R. Sutton Taylor for permission to publish these cases, both of whom were under his care, to Dr. Hansell of Westminster Hospital for the photographic prints, and Dr. Morgan, also of Westminster Hospital, for the photomicrograph.

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Second International Conference on Endodontics

The Second International Conference on Endodontics will be held during the week of June 22, 1958, at the University of Pennsylvania, Philadelphia. For information write to:—Mrs. M. Kolb, Secretary, 4001 Spruce Street, Philadelphia 4, Pennsylvania.

THE CRAWCOURS

By **J. MENZIES CAMPBELL**, D.D.S., F.D.S., F.R.S.E.

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TO-DAY, amalgam is universally accepted as an invaluable agent in conservative dentistry. For this, due credit should be given to Greene Verdiman Black, who, as the outcome of prolonged and intensive investigation, was in 1895 able to present a balanced product to our profession.

Nevertheless, its earlier history was of a decidedly chequered nature. In the late 1820s and early 1830s, several French dentists including Messrs. Mallan were practising in Great Britain; and advertising "Mineral Succedaneum" as being the latest and best medium for filling teeth.

However, the Crawcours freely stated (and this apparently was never controverted by competitors) that they were "the sole and original proprietors" of this preparation; other evidence seems to confirm the accuracy of their claim.

There were many Crawcours, all notorious empirics of French extraction. They designated themselves surgeon-dentists, an appellation believed to have been introduced by Pierre Fauchard.

Research concerning individual members of this family has proved extremely difficult. This is due mainly to the fact that it was customary for most of them to advertise merely as "Mr." or "Messrs." Crawcour.

It has, nevertheless, been established that one of them was, early in the 1780s, visiting cities and towns in the north of England.

The writer has been fortunate in unearthing a descendant (now deceased) of the Crawcours. From him he learned that one family consisted of five brothers (all dentists)—Barnet (1776–1834), Moses (died 1858), David, Israel, and Abraham. Their sons, too, followed the same occupation.

In 1805, there was a Mr. Crawcour, surgeon-dentist, at 439 The Strand, London: and two years later at No. 46. In 1831, the firm of Crawcour and Sons was located at Commercial Road, East. In 1833, S. C. Crawcour announced that he was a member of the firm of Monsieur Crawcour and Sons, late of Bond Street, Piccadilly, and Commercial Road.

The policy of all the Crawcours was to advertise extensively, proclaiming in a reckless manner unusual skill and ability to preserve the natural teeth. For this purpose, they exploited their "Mineral Succedaneum".

They claimed that it was the equal of gold as a filling, besides costing considerably less. It was, in fact, an amalgam comprising mercury and coarse filings from French silver coins. With this, they professed to be able to fill teeth "in about two minutes, without the slightest pain, inconvenience or pressure". They were not interested in the excavation of caries, except the barest minimum removed *only* when essential for a filling to be inserted.

From newspaper advertisements, it is evident that the ramifications of these charlatans were extensive. They systematically visited innumerable cities and towns in Great Britain, besides continuing to practise at Paris. Sometimes, they rented rooms in houses: on other occasions, accommodation in shops. For instance, in Exeter in 1805, one of them consulted in a grocer's premises—not unusual in those days, when itinerant dentists sometimes consulted at the local plumber's.

As was to be expected from the Crawcours' ignorant methods, cases of pulpitis and/or alveolar abscesses frequently occurred. The burden of extracting such painful teeth later devolved on the more reputable dentists and surgeons.

Nevertheless, despite excessive fees, laymen were only too willing to submit to any procedure which did not involve extraction of teeth in these pre-anæsthetic days. Thus, the professions and glamour of the Crawcours being hypnotic, they ensnared innumerable gullible victims.

In 1833, they arrogantly prefixed "Royal" to the name of their filling material: simultaneously claiming to be surgeon-dentists to

the Royal Family and patronized by the Courts of Austria, France, Russia, Prussia, and Belgium.

Having been so outstandingly financially successful in Great Britain, two of the brothers decided to visit the United States, avidly confident that similar prosperity awaited them there. When they introduced "Royal Mineral Succedaneum" into New York in 1833, the tactics pursued were similar to those in force in Great Britain.

It is a matter of American history that, for a time, fillings of this material, because of their easy and quick insertion, did markedly supersede painful and tedious gold foil pluggings, even those of such skilful exponents of this art as Eleazer Parmly, Elisha Baker, and Isaac John Greenwood.

Reputable transatlantic dentists were indignant and unhesitatingly denounced the Crawcours as impostors and national menaces. Spooner, writing in 1836, has recorded certain interesting facts concerning "these swindling villains" (as he termed them), who in a few months amassed a fortune without conferring the slightest benefit on any of their dupes.

However, mystery is the essence of empiricism; when this vanishes, so do the patients! It was the beginning of the end for these unscrupulous quacks, when medical and dental practitioners in America were able to convince the laity that mercurial salivation frequently resulted from the clumsy application of the Crawcours' fillings. These were inserted, without any regard to the anatomy of the teeth, in excessive quantities—more or less in the nature of soft "mounds"—on the occlusal surfaces. Consequently, when the jaws were approximated, the excessive mercury was immediately expelled and swallowed.

These laudable exposures eventually so stirred the public that nation-wide indignation arose, and the brothers Crawcour were forced, in 1834, to make an ignominious flight from America. Nevertheless, in spite of such a disastrous experience there, the returned exiles, and their dentist relatives who had continued to practise in Great Britain, persisted in an extensive advertising campaign.

Subsequently, there was one fundamental difference—no mention of "Royal Mineral Succedaneum". Instead, they asserted that they had discovered an entirely new filling material, "Royal Asiatic Puzzolano". Actually, it was the identical product (with its attendant dangers) masquerading under another name.

They claimed that their technique for filling a tooth was now so improved with this substance that it (to quote their own words) "is performed in a few seconds, inserted in a soft state without pain or pressure, hardens into enamel, allays the most excruciating pain (preventing the necessity of extraction) and lasts for years".

It would be unreasonable to expect such gross impositions to persist indefinitely. There had been incalculable injury to health, and the prestige of the dental profession had been lowered. In this connexion, how true are these words of Abraham Lincoln: "You can fool all the people some of the time and some of the people all the time, but you can not fool all the people all the time".

It is significant that, despite a very prolific array of Crawcours practising dentistry throughout Great Britain for almost a century, only one bearing the name, John Crawcour, was entitled to register under the Dentists Act, 1878, as being "In practice before July 22, 1878". None registered under the 1921 Act.

For readers interested in this subject with its tragic aftermath, the amalgam controversy, the writer would suggest the undernoted as a few of the many sources of information:—

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RADIOGRAPHIC DETERMINATION OF PERIAPICAL DISEASE

By **SYDNEY BLACKMAN**, L.R.C.P., M.R.C.S., D.M.R.E.
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PERIAPICAL disease embraces all lesions of an inflammatory nature, traumatic or bacterial in origin, which are located in and around the apex of a tooth or root. The pathological changes at this site may develop from within or without the tooth socket, from the tooth itself, or from the surrounding supporting bone structure. In some cases the infection may be blood borne. These changes occur in the closest proximity to the apical end of the tooth and involve all the tissues, soft or hard, situated in this limited area.

These periapical lesions are subject to progressive and retrogressive variations which may take place simultaneously in the tissues surrounding the apex of the tooth and its pedicle of nutrient vessels and nerves. The inflammatory reaction may be acute or chronic and involve the terminal part of the pulp canal, the apical cementum and dentine, the periodontal membrane, the lamina dura of the distal end of the socket, and the cortical bone of the alveolar process. Which of these structures becomes affected, the order of attack and sequence of destruction, depends upon the cause of the lesion, the point of origin, the direction of spread of the disease, and the severity of the infection.

The reaction of the tissues to inflammation is governed by the number and virulence of the invading organisms and the resistance of the patient. Although the tendency is towards disorganization and destruction of the body tissues, arrest of the disease can occur at any stage with subsequent repair of the destroyed tissue.

THE ROLE OF RADIOGRAPHY

Radiography is invaluable in depicting the presence of a pathological condition. In some instances, it is the sole means of an early diagnosis.

Repetitive films taken under standard conditions should reveal the presence of progressive tissue resorption or the arrest of the destructive condition. Repair is shown in the deposition of new bone formation.

The efficacy of treatment of periapical disease may be assessed radiographically and therapeutic measures adjusted according to the reaction of the patient. The radiographic control, however, is of value only if there is a full understanding of the many changes which can take place in such lesions.

Early Radiographic Signs.—In the early stages of acute inflammation, before the hard structures have been involved, no definite radiographic signs are visible. As soon as abnormal shadows are seen around the apex the lesion has passed into the sub-acute or chronic phase.

The swelling of the inflamed periodontal membrane around the apex of the tooth cannot be seen on a radiograph, as the soft tissues do not cast any shadow on the film. If the engorged enlargement of the membrane persists for any length of time, the hard encompassing structures of the cementum and lamina dura become eroded and the normal thin linear black image between the root and the socket on the radiograph will appear thickened and irregular.

The opaque structure of a root or of the bone is demonstrable on a radiograph, showing quite clearly an erosion of the apical part of the tooth or a break in the continuity of the lamina dura. As the periapical disease progresses, destruction or resorption of the root can be seen and extension into the osseous support to the tooth is depicted as loss of the bone pattern with rarefaction.

COURSE OF PERIAPICAL DISEASE

Except in the case of mechanical injury, periapical disease occurs by way of a descending pulpitis causing the death of the pulp. Commencing at a carious area on the crown of the tooth, it travels along the pulp canal to the extreme apical end of the root and the

infection reaches the outer surface of the tooth through minute openings at the very apex of the root into the surrounding periodontal membrane.

A chronic apical periodontitis is thus produced in the form of an inflammatory infiltration of the periodontal membrane and the

Fig. 1.—Chronic apical periodontitis. Irregular thickening of the apical periodontal membrane shadow. Lamina dura unbroken but thin. Slight roughening of the apex of the tooth. No cortical bone change.

Fig. 3.—Chronic dento-alveolar abscess. Localized periapical area of rarefying osteitis with bone destruction. No erosion of the apex. Root appears to be dipping into the abscess cavity.

infection tends to remain localized (*Fig.* 1). Evidence of existing focal infection is often first found during a routine X-ray examination, with complete absence of local symptoms. Clinically, a tooth, although sensitive to percussion and tender locally, will probably exhibit no subjective symptoms.

Slight widening and irregularity of the apical periodontal space is seen on the radiograph and appears as a bead or blob, but with no apparent

Fig. 2.—Chronic apical periodontitis with local osteitis. Break in the lamina dura. The periodontal membrane shadow has merged into an ill-defined, irregular, diffuse black area of rarefied apical bone. First stage of rarefying osteitis secondary to an apical lesion.

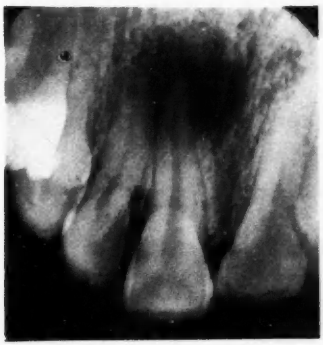

Fig. 4.—Periosteal abscess. Rounded dark shadow at apex. No signs of capsulation, no break in lamina dura, no signs of osteolysis.

change in the image of the lamina dura. In the more chronic cases the periodontal membrane displays a pronounced thickening, a thinning of the lamina dura, and a bowing into the medullary bone. Resorption of the apex is unusual at this stage where the infection is of a

low-grade variety and the whole condition may lie dormant until a renewed inflammatory activity is set in motion. At most, the root

Fig. 5.—Root resorption. Loss of the apical periodontal membrane shadow, leaving an irregular dark area of bone-loss, housing a mass of granulation tissue.

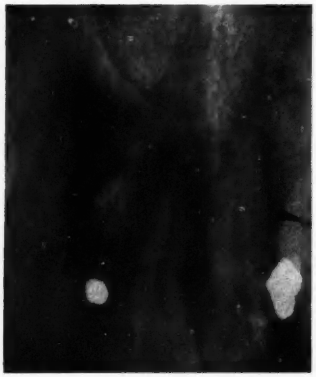

Fig. 7.—Root resorption. Lateral erosion and indentation of the apices of the roots of the teeth.

may show some roughening or slight erosion at the apex.

Lesions of this type may be produced, also, by the spread of the disease from a neighbouring apical infection or from a gingival inflammation tracking along the length of the periodontal membrane. In addition, traumatic concussion of the apical periosteum is sometimes followed by a superimposed infection.

Chronic Apical Abscess.—Active periapical disease may attack, erode, and destroy the immediate structures which bound the periodontal membrane at the apex and the radiograph will show signs of spreading tissue destruction (*Fig.* 2). The lamina dura loses its clear outline and reveals a break in its

Fig. 6.—Root resorption. Large part of both roots are resorbed with rounded convex surfaces of their terminal ends.

Fig. 8.—Root resorption. Oblique destruction of the root of the tooth.

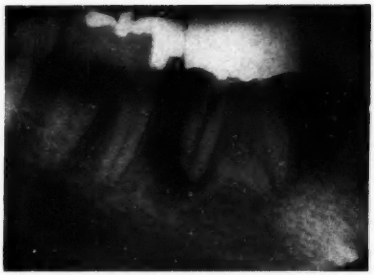

Fig. 9.—Root resorption. The root of the tooth appears to have been sawn across.

continuity. The periodontal membrane shadow surrenders its identity and merges into an ill-defined, irregular, diffuse black area or rarefied apical bone.

This is the radiographic appearance of a chronic apical or dento-alveolar abscess exhibiting a rarefied local area of bone destruction usually produced as an exacerbation of a

long-standing periapical infection (*Fig.* 3). If unhalted, the inflammatory process will attack more of the surrounding bone structure and set up an osteitis in its different forms.

Even at this stage the radiograph may not show any obvious erosion or resorption of the apex and the end of the root may appear to be dipping into an abscess cavity. Such abscesses are more likely to be associated with the bone than with the tooth.

Fig. 10.—Rarefying destructive osteitis. A periapical granuloma has broken down into a dento-alveolar abscess. The bone destruction is spreading centrifugally from the apical region of the tooth.

Fig. 12.—Rarefying destructive osteitis. Commencing as a periapical lesion, the extension of the bone destruction has been towards the alveolar margin. The bony interdental septa on both sides of the affected tooth have been destroyed. There is usually a fistulous discharge at the gingival margin.

Sometimes a rounded dark shadow is found around the apical part of the tooth socket with no signs of limitation, no break in the lamina dura, and no signs of osteolysis (*Fig.* 4). The external manifestation of this condition is a tender buccal or labial swelling which, if incised, releases an accumulation of inflammatory exudation or pus. This is probably a subperiosteal abscess lying outside the socket and radiographically does not show any

Fig. 11.—Rarefying destructive osteitis. Lateral spread of the destructive process of the outer wall of the socket of the neighbouring teeth.

Fig. 13.—Rarefying destructive osteitis. The destructive process has spread across the transverse axis of the mandible to the lingual plate.

destruction of the spongiosa, most often arising from a sub-acute periapical lesion.

Each case of periapical disease demands its own particular consideration as to treatment and the problem of extraction can only be solved after due assessment of the degree of virulence of the inflammation, the extent of destruction shown on the radiograph, and the

systemic disturbance in the patient. There is always the possibility that the condition may remain quiescent and eventually resolve.

Root Resorption.—The root of a tooth in which the pulp has died frequently undergoes a gradual resorption due to chronic periapical infection. As the apex becomes resorbed, the periodontal membrane shadow widens and becomes irregular in shape leaving behind a radiolucent area of bone-loss, housing a mass of granulation tissue (*Fig.* 5).

Tooth resorption is progressive, starting in the apical region, denuding the apex of its cementum, and attacking the dentine (*Fig.* 6). A large part of the root may be destroyed. All degrees of resorption may be seen: rounded convex surface of the terminal end (*Fig.* 6), lateral indentation (*Fig.* 7), oblique destruction (*Fig.* 8), and root-stumps which appear to be sawn across (*Fig.* 9).

Resorption of the apex and deposition of secondary cementum may alternate in the same tooth, even though they are antagonistic processes. On the other hand, if the infection is severe, the resorption of the root may be

Fig. 14.—Chronic osteomyelitis. There has been a lateral extension of bone destruction from an apical infection. A large part of the alveolar bone is involved with sequestrum formation.

Fig. 15.—Dento-alveolar abscess. Divarication of the apices of the teeth with approximation of their crowns. At operation the abscess was contained in a fibrous sac.

Fig. 16.—Residual infection. This is a specific form of chronic rarefying osteitis. Numerous small punctate black spots are seen indicating confluent bone spaces filled with plugs of pus.

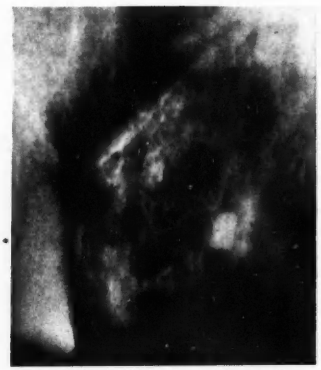

Fig. 17.—Residual infection. The confluent bone spaces are larger, and a greater area of the bone shows chronic rarefying osteitis or osteomyelitis. A large piece of the alveolar bone is undergoing separation to ultimate sequestration.

accompanied by chronic rarefying osteitis with suppuration and bone destruction (*Fig.* 6).

Suppurative Osteitis.—In the absence of resolution, the periapical lesion will proceed unchecked and extend in all directions from its apical centre and continue its destructive

Fig. 18.—Rarefying destructive osteitis. The apical dento-alveolar abscess assumed a sudden and acute activity, perforating its own fibrous capsule. Rapid bone destruction in the upper premolar region extending to the floor of the maxillary antrum.

activity in the form of suppurative osteitis. The extent of the tissue destroyed and the direction of the spread is unpredictable, but it is always in the path of least resistance. It may spread centrifugally beyond its own apex into the main bone (*Fig.* 10), laterally to the periapical regions on either or both sides (*Fig.* 11), in the opposite direction towards the free margin of the alveolus (*Fig.* 12), or across the transverse axis of the bone to the periphery, buccal or lingual (*Fig.* 13).

Travelling along the base of the interdental bone septum, the infection forces its way to the outer wall of the socket of the adjacent tooth and may penetrate the lamina dura (*Fig.* 11). This invading destructive osteitis loosens the adjoining tooth in its socket and tends to isolate the intervening bony septum, progressing from osteitis to osteomyelitis with sequestrum formation (*Fig.* 14). If treated by early incision into the abscess cavity, pus is released and the wall of the second socket will repair quickly and the tooth should not lose its vitality.

It is unusual to find an area of suppurative osteitis producing separation of the teeth, but when it does occur, the divarication is between the apices of the neighbouring teeth with approximation of their crowns. The separation

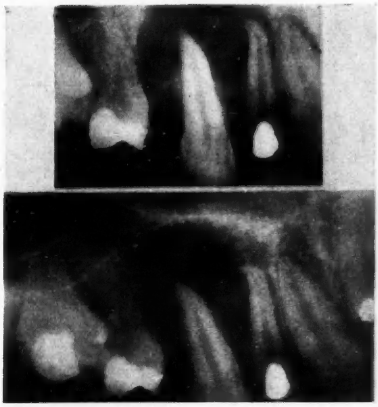

Fig. 19. Rarefying destructive osteitis. The destructive process has extended centrifugally away from the apex towards and into the floor of the maxillary antrum.

of the teeth as seen in the radiograph (*Fig.* 15) is instructive as, at operation in seven recent cases with almost identical radiographs, the areas were found to be enclosed by large fibrous sacs.

Rarefying Destructive Osteitis.—A chronic low-grade infection sometimes advances as a slow infiltration into the spongiosa of the surrounding bone and insidiously destroys the septa between the close-set spaces of the cancellous network. The cell-like spaces grow larger and contain plugs of inspissated pus and are depicted on the radiograph as small, black punctate shadows in the general bone pattern of the existing rarefying osteitis (*Fig.* 16).

This condition, often alluded to as residual infection, can remain quiescent for a long time, especially after the extraction of an infected tooth or with the retention of a necrotic root fragment. If, however, the infection continues to spread, it may slowly and gradually invade the cancellous structure and initiate a marked degree of confluence of the cell spaces. The small circular black images assume larger

proportions and eventually sizeable pieces of bone become isolated as sequestra in an area of bone which is now the subject of osteomyelitis (*Fig.* 17).

The majority of cases of rarefying destructive osteitis spread by a radiating insidious advancement into the immediate bone-tissue

Fig. 20.—Dento-alveolar abscess. Oval-shaped black area in $\underline{|234}$ region which appears to incorporate all the three teeth. This is a periapical abscess arising from the $\underline{|4}$, tracking behind $\underline{|23}$ on the palatal aspect of their apices.

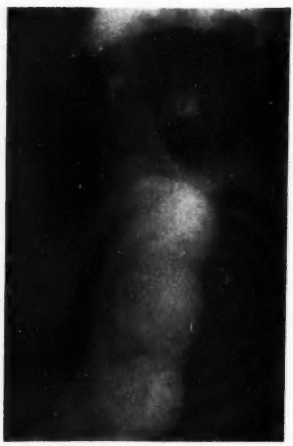

Fig. 22.—Pathological fracture. Occlusal view of the left side of the mandible showing an area of destructive osteitis with sequestra. The buccal and lingual plates have been penetrated because of inefficient drainage of the abscess cavity.

and are shown on the radiograph as irregular diffuse dark areas of rarefaction issuing from the apical region of a tooth (*Fig.* 18). These areas vary in size and are devoid of any limiting cortical wall or circumscribed margin. The centre of the dark area is never as radiolucent as that of a dental cyst, and its density is in direct ratio to the concentration of pus or quantity of bone debris in the abscess area.

The acute exacerbation of a chronic osteitis following upon a periapical lesion should always be regarded with full seriousness, as

Fig. 21.—Resolved dento-alveolar abscess. Same patient as *Fig.* 20, after the extraction of $\underline{|4}$ six weeks previously, with efficient drainage of pus. The laminæ dura of $\underline{|23}$ are normal and show no signs of apical periodontitis.

Fig. 23.—Destructive osteitis. The infection has spread from an apical dento-alveolar abscess to and through the lower border of the mandible. Much bone has been destroyed in its wake with sequestra formation.

the spreading destruction may encroach upon and involve vital anatomical structures and tissues. In the upper jaw the advancing erosion of the infection may reach the nasal fossa or the maxillary sinus and penetrate their respective floors and so produce alarming complications (*Fig.* 19). The floor of the antral sinus is formed by the widened base of the inverted triangular alveolar process of the maxilla and pus may track its way into the cancellous spaces on the palatal aspect of

the apices of the upper teeth and produce a radiographic illusion of periapical disease of teeth adjoining the tooth solely affected (*Figs.* 20 and 21).

In the mandible the destructive osteitis may find its way either to the buccal or lingual

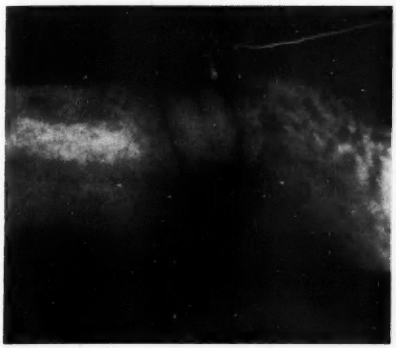

Fig. 24.—Destructive osteitis. The spreading osteitis has encroached upon the mental foramen and inferior dental canal.

plates of the lower jaw (*see Fig.* 13) and, in the absence of efficient drainage, produce a pathological fracture (*Fig.* 22). More commonly, however, the pus may make its way slowly to the lower border of the bone (*Fig.* 23), pierce it and discharge through a sinus on to the side of the face. In the bicuspid and molar regions the osteitis may encroach upon the mental foramen and inferior dental canal (*Fig.* 24).

Granuloma.—In contrast to the subperiosteal abscess (*see Fig.* 4) a rounded dark area may be seen at the apical region of a tooth, distinctly encompassed by a limiting structure, "cortical" in appearance, and definitely continuous with the lamina dura of the tooth socket. The enclosed mass (*Fig.* 25) is composed of inflammatory-cell infiltration in the periodontal membrane at the apex of the tooth and radiographically allows the X-ray beam partially to penetrate it and cast a black shadow on the radiograph.

The lesion is an apical granuloma and is a common entity arising from a pulpitis of low-grade infection. It is walled in by a fibrous capsule and contains fibroblasts, some epithelial cells, and numerous small capillaries. The granuloma may remain of small size for a long time with the fibrous capsule preventing resorption of bone. The longer the granuloma

Fig. 25.—Encapsulated apical granuloma. Rounded dark area continuous with the periodontal membrane shadow and encompassed by a limiting structure. The internal small dark spots indicate a breaking down of the central mass which will form an apical abscess.

Fig. 26.—Cementoma. Sclerotic localized area at the apex of the tooth which is replacing the soft apical granuloma.

persists the greater the fibroblastic reaction, especially at the periphery.

Occasionally the granuloma is seen on the radiograph to be punctuated with small black spots and proceeds to break down in its centre destroying its own capsule and forming a

dento-alveolar abscess. A necrotic area is then produced and the radiograph shows the extension of a rarefying destructive osteitis which by a peripheral spread may involve a large area of the jaw.

The apical granuloma may undergo a healing process and ossify into a sclerosed mass at the apex (*Figs.* 26 and 32). When revealed on the radiograph, it may be acclaimed as a cementoma.

Fig. 27.—Epitheliated granuloma. The granuloma is surrounded by a definite layer of cortical bone which is continuous with the lamina dura of the socket. Histopathological examination showed the capsule to be lined by epithelium. This entity is a potential dental cyst.

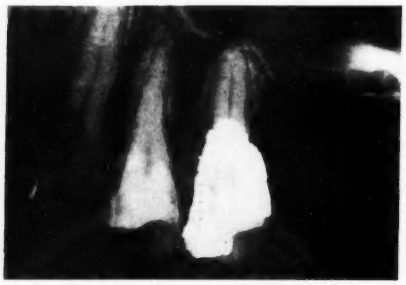

Fig. 29.—Condensing osteitis. Linear deposit of new bone on outer aspect of the socket wall incorporating the lamina dura.

All granulomata contain some epithelial cells and these are derived from the cell rests of Malassez found in the periodontal membrane. The central cells degenerate, rupture, and liquefy and promote a transudation of fluid in the lumen of the cavity which is contained within a fibrous capsule lined by epithelium.

Radiographically an epitheliated granuloma (*Figs.* 27 and 28) appears on the film as a clearly defined semi-radiolucent area at the apex of a tooth, root, or socket, black or grey in colour, and with little signs of internal bone trabeculation. It is enclosed by a layer of condensed cortical bone which is continuous with the lamina dura of the socket. With the formation of fluid within the granuloma, a dental cyst is produced and the enclosed area becomes radiolucent.

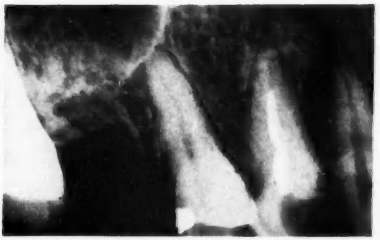

Fig. 28.—Epitheliated granuloma. This granuloma is situated to one side of the apex and might have developed into a lateral dental cyst. The internal shadow of the granuloma is dark and is due to degeneration of the central cells with fluid formation. Histopathological examination showed the capsule to be lined by epithelium.

Fig. 30.—Condensing osteitis. Bony encirclement enclosing localized small apical abscess. No erosion of the apex.

It is not possible by the radiograph to determine whether the entity is an epitheliated granuloma or a potential dental cyst. The majority of small cystic granulomata give rise to no signs or symptoms and are generally found by accident during the course of a routine X-ray examination of the teeth. They

may never grow to any appreciable size and their enlargement follows an increase in the internal cystic or fluid pressure.

Resolution and Condensing Osteitis.—Arrest of the destructive processes associated with periapical lesions can take place at any stage of the disease. The destroyed tissues may be replaced or re-constructed, commencing with the formation of granulation tissue. There may be localized fibrous encapsulation of an abscess, or calcification of a necrotic area with deposition of sclerotic new bone. Should any of these end-results materialize, the tooth would be able to continue its function in the mouth. Fibroblastic reaction is superseded by osteoblastic activity, and condensing osteitis with bone regeneration is observed on the radiograph.

Fig. 31.—Condensing osteitis. Osteoblastic new bone cluster formation around the outer part of the apical region of the tooth socket. No periodontal membrane change. No break in the lamina dura.

The type of new bone formation bridging an abscess cavity varies from reconstituted normal bone trabeculation, cluster bone deposits around the apical part of the socket, linear condensed bone outside the lamina dura, to dense homogeneous sclerotic bone. There is no control over the shape or density of this new bone and it bears no relationship to the causative factor or to the extent of bone destruction. When normal bone structure replaces destroyed cortical bone, the resultant pattern may be similar to the spongiosa, and the socket re-made with an apical lamina dura and periodontal membrane.

Often one sees a linear deposition of bone on the outer aspect of the socket wall incorporating the lamina dura. It simulates a bony reinforcement and osseous condensation barrier to combat and stem the destructive forces and to consolidate the weakened fortress against any further attack (*Fig.* 29). This reparative condensing osteitis is found in cases of low-grade infection, mild in character, and is different from the new bone formation stimulated by occlusal stress. It is not homogeneous in structure and therefore unlike compact bone.

Fig. 32.—Cementoma. Opaque periapical bone formation. Often described as a cementoma.

More commonly, repair is shown in the form of an insidious bone encirclement walling off a localized small apical abscess (*Fig.* 30). In many cases the severity of the infection may not be sufficient to cause erosion of the apex of the tooth: in others, there may be an appreciable amount of apical resorption with reactive hypercementosis of the root.

Another type of reparative bone formation is effected by the laying down of osteoblastic deposits in the form of a cluster around the apex of a tooth, outside the socket (*Fig.* 31). This unusual procedure does not appear to be related to the origin of the infection, its chronicity, or the age of the patient and may precede the formation of the extra-apical homogeneous sclerotic area sometimes observed.

Occasionally the radiograph shows a well-defined circular opaque formation in the periapical region (*Fig.* 32), but the pathogenesis of this entity is not fully established. It could be claimed as the final phase of a cluster deposition or calcification and ossification

in a granuloma. It has also been described as a cementoma, but whatever its origin, the periodontal membrane shadow at the apex of the tooth is entirely obliterated by a bridge of bone across this area anchoring the tooth to the socket wall and is an example of root bony ankylosis.

Areas of destruction may be repaired if the irritation is removed and the infection subsides

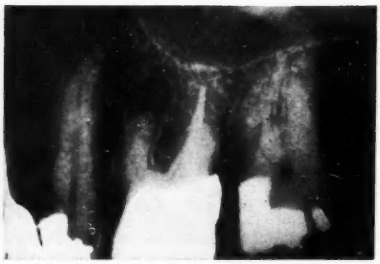

Fig. 33.—Root resorption. Stunted root with complete bone regeneration, simulating normal bone structure. Socket re-formed together with periodontal membrane.

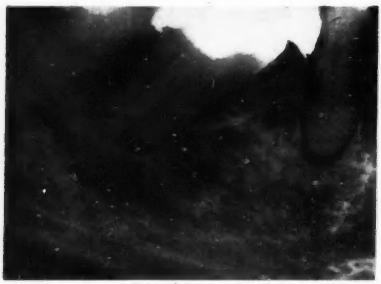

Fig. 35.—Hypercementosis of root. Bulbous enlargement of the distal part of the root with limited degree of apical resorption. Masking of the apical foramen. Diffuse sclerosing osteitis.

—provided that sufficient periodontal membrane is left in connection with the socket. Complete bone regeneration can occur simulating normal bone structure (*Fig.* 33) distal to a stunted root together with a re-formed socket and periodontal membrane.

Sclerotic bone formation as a result of condensing osteitis indicates another form of tissue repair, and is found either localized (*see Fig.* 8) with limited damage to the bone or, if the infection has been widespread, diffuse in area and of ivory denseness in continuity with the marrow spaces of the obliterated bone (*Fig.* 34). There is complete ankylosis of the tooth to the socket wall.

All the foregoing changes of condensing osteitis are radiographic signs of arrest of periapical disease, limiting and repairing the destruction of the surrounding bone tissue.

Fig. 34.—Root resorption. Diffuse sclerotic bone deposition. Apposition of new bone obliterates the marrow spaces and resembles compact bone. Irregular homogeneous opaque area around the apices with definite demarcation.

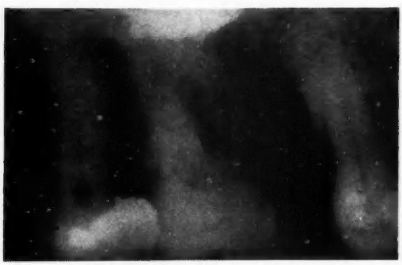

Fig. 36.—Exostosis of the root. Irregular mass deposition of cementum on the apical part of the root within the socket, with some resorption of the apex. Socket wall and lamina dura have adapted themselves to the root enlargement. No thickening nor irregularity of the periodontal membrane shadow.

Thus, the dental surgeon obtains information so essential in his approach to the treatment of the inflammatory condition and is able to determine whether the infection has or is subsiding and the possibility of retaining the tooth in the jaw.

Hypercementosis.—The deposition of secondary cementum with hypercementosis around a resorbed root is a common form of arrest and repair of a destructive periapical lesion

(*Fig.* 35). The enlargement of the distal part of the root, bulbous in shape as a rule, is a secondary osteocementum deposition promoted by cementoblastic activity where the effect of the inflammation is mildly irritating and where the periodontal membrane is not completely destroyed.

In cases of hypercementosis, the radiograph generally demonstrates a masking of the apical foramen. This is produced by ingrowing cementoblasts on the inner surface of the root canal and assists in protecting the apex against resorption. When associated with apical resorption, the sclerosing osteitis is more diffuse and indefinite in shape (*Fig.* 35).

Not every case of hypercementosis assumes a regular conformation. Some exhibit an irregular deposition involving the distal half of the root which has first undergone an appreciable amount of resorption (*Fig.* 36). This condition, often referred to as exostosis of the root, is not accompanied by any thickening or irregularity of the apical periodontal membrane, but shows an adaptation of the socket to the irregular root mass. The linear space between the root and the socket wall is clearly visible indicating that there is no sign of a calcified union or ankylosis of the root to the lamina dura.

SUMMARY

The importance of radiographic examination in periapical lesions and their sequelæ is most obvious and cannot be over-emphasized. The radiograph assists in determining the site of the infection, structures involved, extent and activity of the destructive processes, signs at attempted arrest of the inflammation, and the existence of actual resolution. From the clinical viewpoint, the first essential step in the treatment of an abscess or suppurating osteitis is ample incision with free efficient drainage of the pus.

Acknowledgements.—I wish to express my thanks to my colleagues on the staff of the Royal Dental Hospital, London, for permission to follow-up their cases, and record my extreme indebtedness to Dr. Mandiwall, the Director of the Photographic Department, and to his Chief Technician, Mr. J. Shilland.

Quantitative Evaluation of the Therapeutic Effect of Selective Grinding

Using a periodontometer, developed by Muhlemann, measurements of tooth mobility were made in 9 patients with a unilateral masticatory function. Before grinding, tooth mobility was 30 per cent higher on the hypofunctional side compared with the hyperfunctional one, being highest in the balancing area of the hypofunctional side.

Selective grinding, directed at re-establishment of bilateral function, reduced mobility on the hypofunctional side by 18·1 per cent and on the other side by 8·7 per cent. Where the asymmetrical function had existed for years, it was not possible to obtain by selective grinding complete symmetry with regard to the amount of tooth mobility.

The authors' conclusions were that re-establishment of function in hypofunctional areas should be attempted, that occlusal contact in the balancing areas should not be attempted and that care should be taken to check the occlusion of the incisors in centric and protrusive relation some time after selective grinding.—Muhlemann, H. R., Herzog, H., and Rateitschak, K. H. (1947), *J. Periodont.*, **28**, 11.

Psychological Aspects of Disruption of Thumb-sucking by means of a Dental Appliance

Three children between the ages of 3 and 6 years underwent intensive psychologic observation during the period that they were wearing a fixed appliance (hay-rake) to break thumb-sucking habits. The authors concluded that, if possible, active intervention of this nature should be avoided until the permanent teeth are erupting, as, before this age, the child is not sufficiently developed psychologically to accept the treatment. In none of the three cases described was the habit broken.—Korner, A. F., and Reider, N. (1957), *J. Dent. Child.*, **24**, 119.

PRINCIPLES OF ULTRASONIC CAVITY PREPARATION*

By **GUY A. MORRANT**, B.D.S., D.D.S., *London*

It seems that hardly a year has gone by since the second world war without there being presented to us some new method whereby tooth structure may be cut more quickly and more easily, and, it is often claimed, less painfully. We have seen the advent of water sprays and washed field techniques. Higher speeds appear to have come to stay and are now reaching astronomical figures with the new Chayes handpiece. A turbine handpiece is available and experiments continue. We have seen the unconventional method of airbrasive come and go, but now another technique, ultrasonics, is hovering in the background asking for recognition.

Before employing and evaluating a new technique, it behoves us fully to understand the principles upon which it is based and especially is this so where entirely new principles are involved. This paper will be an attempt to describe the background to the evolution of such apparatus as the Cavitron dental unit and the prototype Amalgamated Dental-Mullard unit in Great Britain. It is to be emphasized that the author is in no way advocating the use of the ultrasonic cutting method but merely attempting to describe the principles of the method and to present such information as is now available.

The following points were illustrated by an excerpt from a film:—

Ultrasonic waves and sound waves are fundamentally the same and all waves of this type are a form of energy. We hear sound when vibrations travel through the air to our ears. The vibrating surface of a drum, for instance, imparts energy to the air and the air carries this energy in the form of waves. As the drum head rises and falls, so the air is compressed and rarefied with the same frequency. At low frequencies, the amount of energy in the waves is small, but it is enough to blow out a candle flame. The drum head shown is vibrating 128 times every second. The frequency of the vibrations determines the pitch of the note in the musical scale. As the pitch rises, the vibrations become more frequent. A middle C tuning fork vibrates 256 times per second, but an upper C fork, an octave higher, vibrates 512 times per second. The loudspeaker vibrates in the same way as the original force, imparting energy to the air, and is quite efficient at low frequencies, but as the pitch rises it becomes less efficient. Above 10,000 cycles per second its efficiency falls until it cannot be heard at all. We can hear over nine or ten octaves, from 16 cycles per second to between 16,000 and 20,000 cycles per second. Above this we cannot hear vibrations, although they are still physically the same. Frequencies above 16,000 are therefore called ultrasonic waves.

Ultrasonics is a new science, but the use of ultrasonic waves can be found in nature. Bats are one example. They have special organs which can make vibrations up to 70,000 cycles per second and their ears are able to hear these vibrations. By emitting ultrasonic waves and listening for the reflection they can avoid obstacles. Dogs, too, can hear ultrasonic waves, as was discovered in the nineteenth century by Sir Francis Galton, who devised a silent whistle now called the Galton whistle. We can hear only the blowing noise, but the dog can hear the whistle up to nearly a mile away.

Man has applied ultrasonic waves to such uses as probing through the sea. In the same way as the bat, an instrument on the ship projects a beam of waves and another instrument listens for the reflection. The ultrasonic generator is placed in the water, the power is switched on, and the reflections are recorded. Even the presence of a shoal of fish can be detected in this way.

* A paper delivered to the American Dental Society of Europe, July 10, 1956.

The wider use of ultrasonic waves became practical with the use of new types of wave generator. The loudspeaker is a sound wave generator which works by electro-magnetism. A fluctuating electric current flows through the speech coil and produces a fluctuating magnetic field which drives the coil and cone backwards and forwards, so producing vibrations in the air. As we have seen, the loudspeaker is efficient at low frequencies, but not at high frequencies. A type of wave generator called a magnetostrictor is more efficient at high frequencies. The power from a special generating unit is fed through a coil surrounding a core of laminations. It also operates by electro-magnetism; a fluctuating current flows through the coil, but in this case the coil causes the laminated core to change its length, expanding and contracting under the influence of the magnetic field. The effect may be demonstrated by a special magnetostrictor consisting of a long nickel tube around which solenoid wiring provides the magnetic field. A dial indicator is arranged to measure the expansion of the coil when the current is turned on. The current magnetizes the nickel which expands under the influence of the magnetism. For most purposes this principle is put to use by driving a magnetostrictor with alternating current at ultrasonic frequency and the ends can be seen vibrating under the microscope as the current is turned on. Magnetostrictors are most efficient between 5000 and 50,000 cycles per second.

It may be wondered how these ultrasonic phenomena have any application in dentistry. In the first place, magnetostrictors were applied to materials to produce, through their vibrations, accelerated fatigue tests. But there was also the danger that the magnetostrictor itself would rapidly become fatigued. It was discovered that if a tapered stub of carefully calculated dimensions was attached to one end of the laminated core of the magnetostrictor, the vibrations could be considerably magnified. Thus, the same vibrations as used before in testing could be employed, at the same time running the magnetostrictor at a reduced, safe level.

The magnetostrictor and tapered stub, or exponential as it is often called, in effect produced a rapid series of hammer blows on the material under test. Depending on the material, this often resulted in a wearing away or chipping action on the material, produced by the point of the stub. This wearing action, it was found, was greatly accelerated if a mixture of abrasive particles in a liquid was interposed between the point and the material. This mixture is called a slurry and is an essential component of the modern ultrasonic industrial drilling process. The drill consists essentially of two parts, the generator and the magnetostrictor drill head, mounted on a drill stand. In a small 50-watt drill, the latter consists of a laminated central core clamped at its nodal point. This is surrounded by a driving coil which allows the core to move freely within it. On either side is placed a polarizing coil to provide a direct current magnetic field essential for maximum efficiency. One end of the central core has a block brazed to it carrying a threaded socket into which can be screwed various sizes of exponential stub.

Such a drill is, of course, reciprocating instead of rotating in the normal manner. Drill tips, then, are not confined to the circular shape and therein lies the particular value of the ultrasonic drill. By means of the high-frequency reciprocating action and the abrasive slurry, holes of any desired shape may be drilled in the hardest and most brittle substances, such as glass and tungsten carbide. It is obvious that the ability to cut cavities of predetermined shape would be of great advantage in dentistry.

Attempts were made to take a flexible lead-off from the end of the exponential of an industrial drill. Vibrations can, in fact, be transmitted along a stiff wire and a cutting effect can be obtained at the end of the wire. However, such a wire must be fairly rigid and it is difficult to transmit the effect round the sharp bend necessary for a contra angled dental instrument. Furthermore, any attempt to hold the wire in a handpiece tends to damp the vibration and produce heat in the handpiece. Attempts were made to substitute for

the wire a polythene tube filled with mercury but this was a failure.

So development in the dental field has necessitated the reduction in size of the magnetostrictor. Fortunately, the polarizing coils may be dispensed with by superimposing the direct current on the same coil as that carrying the alternating current, and redesigning the laminated core. Nielsen, Richards, and Wolcott (1955) utilized a nickel tube magnetostrictor with permanent magnet polarizing pieces in their experimental handpiece, but it is probable that the commercial handpieces all retain the laminated type of transducer with a tapering or stepped exponential. All this may be reduced to fit into a large-sized handpiece. A feature of the reduction in size is the necessity to institute a water-cooling jacket to dissipate the considerable heat generated in the handpiece. Thus, in addition to the two electrical wires there must be flow and return water tubes attached to the handpiece. However, the larger sized handpiece may not be such a handicap as at first sight might be assumed. With the ultrasonic handpiece there is no torque and hardly any pressure is required. Therefore, the handpiece may be held at a greater distance from the operating tip than is the case with the conventional handpiece.

A further complication is the slurry feed, which must be led to the tip and, for greatest convenience, should be attached to the handpiece. The flow of slurry must be under the immediate control of the dentist and the whole slurry system presents a number of engineering problems. In any reservoir of abrasive and water, the former tends to settle out. The mixture may be made to flow along a tube if agitated in the reservoir, but here again, unless the tube is cleared immediately after operating, there will be a tendency for the abrasive to settle out and block the tube. A suggested scheme is to have the abrasive continually pumped around a wide bore circuit, in and out of the reservoir tank, from which a small lead-off is taken down to the handpiece and back again. This circuit is tapped by a small trigger on the handpiece. Mains water or compressed air spray can be led into this smaller diameter circuit to clear it after operating. The water or spray can be solenoid operated. In addition, water or spray is necessary to clear the field of slurry periodically during operating, in order to observe progress, This again is best solenoid operated and should, for maximum convenience, also be mounted on the handpiece. Thus, there are four or five tubes, plus the electric wires, necessary for the best operation of the ultrasonic handpiece.

The rate of cutting of any ultrasonic drill depends largely on the amplitude and the abrasive. The amplitude of the Cavitron unit is about 1·6 thousandths of an inch and the generator produces 200 watts, providing a frequency of 29 kilocycles. The present Ash-Mullard prototype operates at approximately 27 kilocycles and 120 watts to give about 1½ thousandths of an inch amplitude. It is probable that further types of apparatus will be possible, operating at a lower wattage giving the same or greater amplitude, thus economizing in the initial production costs and reducing the amount of cooling required at the handpiece.

A typical Cavitron unit consists of a large cabinet containing the generator and the slurry pump system. The generator has two controls, one of which tunes the handpiece to the different tips and the other, marked "output", is, presumably, to vary the amplitude. However, in practice it seems that one tends to use maximum amplitude otherwise the rate of cutting falls off. The rate of cutting, when everything is working satisfactorily, compares favourably with cutting speeds obtained with conventional instruments. However, if ultrasonic methods are to compete successfully in operative dentistry, it is with the modern high-speed operating techniques that it will have to go into competition.

Another factor of mechanical importance in operative technique is the wear which takes place on the cutting tip. This is quite rapid and tends to round off all sharp angles in wearing away. This wearing is due to the action of the abrasive on the tip and severely limits the number of cavities which can be produced by any one particular tip.

Changing tips at the present time is a tedious matter since the only means of attaching them to the handpiece is by a screwed thread. They must be very firmly secured in order to provide complete continuity between the handpiece and the tip, and even when tightened with pliers, they sometimes come loose. It is possible that this is a fault which may be overcome in subsequent development. In practice one finds oneself tending to use the round tips because these are universally applicable at all angles. Since the side cutting effect is quite marked, it was found that one tended to use the round tip somewhat after the fashion of a fissure bur.

With regard to the biological effects, histological evidence so far published appears inconclusive. Hansen and Nielsen (1956) reported interruption of amelogenesis in the continuously erupting incisor of the guinea-pig. Other reports suggest that pulp inflammation under ultrasonic cavity preparation is little different from that under conventional instrumentation. Claims that the ultrasonic process is less painful should, in the author's opinion, be treated with extreme reserve, although the vibration felt by the patient is much less than that produced by burs and diamonds. However, there must be, by the very nature of the cutting action, extreme stimulation of the cut dentine surface and, although the tip is cooled by the flow of slurry, a certain amount of heat is generated. Furthermore, if, as sometimes happens, the amount of slurry in the cavity drops below a certain critical level, what is left is rapidly atomized and in this case the heat rises very quickly. Heat generation would, therefore, appear to be one of the additional clinical hazards to be controlled if the technique is to be successful.

SUMMARY

The principles and background underlying the development of the ultrasonic dental drill are described, together with experiences observed in the development of a prototype ultrasonic dental drill. Various mechanical difficulties are recorded and the necessity for caution in evaluating the biological response is stressed.

REFERENCES

HANSEN, L. S., and NIELSEN, A. G. (1956), Comparison of Tissue Response to Rotary and Ultrasonic Dental Cutting Procedures, *J. Amer. Dent. Ass.*, **52**, 131.

NIELSEN, A. G., RICHARDS, J. R., and WOLCOTT, R. B. (1955), Ultrasonic Dental Cutting Instrument, I, *Ibid.*, **50**, 392.

LETTERS TO THE EDITOR

November 1, 1957.

Dear Sir,

Professor Ballard states in his presidential address to the British Society for the Study of Orthodontics, published in the October [Vol. VIII, p. 42] number of the *Dental Practitioner*, that the good work started by Brash in 1929 "is being completely undone" by the authors of Part II of the second edition, and quotes the matter of the difference in the diameter of the humeri in Irish and Italian workmen. The data quoted is from Hrdlcka, an eminent anthropologist, who wrote: "There are interesting differences. Some of these may be racial, but most are probably functional, occupational. The Irish males, representing mostly men of hard labour, show the strongest humeri; the Italians, both sexes, the least strong." In the same number of the *American Journal of Physical Anthropology*, Dr. H. B. Collins, then a member of the division of Ethnology of the U.S. National Museum, writes of the living Alaskan Eskimo: "For as long as the Eskimos adhered to their native diet, consisting mainly of sea mammals and fish, rich in the essential food elements and requiring hard usage of the teeth and jaws, dental decay and crowding of the teeth were practically unknown."

We considered it our duty to refer to the work of men like Hrdlcka, Collins, and others, who believe that function does play a part in the determination of skeletal morphology, as well as to those who believe that it does not. The complex processes involved in the aetiology of malocclusion are not made any more simple by merely making sweeping

dogmatic and unsubstantiated statements like "it is more evident than ever that malocclusions are not the result of environmental factors acting post-natally". More evident to whom and on what evidence?

Yours faithfully,

JAMES SCOTT.

Department of Anatomy,
Queen's University of Belfast.

Dear Sir, *November* 5, 1957.

I am afraid that Mr. Emslies' reply to my letter does not go far enough. Perhaps I should put my query more precisely.

Given a conscientious and healthy patient having had a properly executed gingivectomy and well-designed paradontal splints, how long will the splinted teeth last?

Other things being equal the extension of life of splinted teeth varies with the individual stress system, which being indeterminate makes accurate forecasting impossible, but extensive experience of paradontal splints must shed some light on prognosis.

Yours faithfully,

J. D. MANSON.

168, *Chapeltown Road,*
Leeds, 7.

BOOK REVIEWS

DENTAL HEALTH EDUCATION. By FRANCES A. STOLL, R.D.H., Ed. D., Associate Professor of Dental Hygiene, Director of Courses for Dental Hygienists, Columbia University. 9½ × 6 in. Pp. 196, with 16 illustrations. 1957. London: Henry Kimpton. 34s.

IN the preface it is set out that the book "is written to fill the need for a text on teaching for dental health" and there is no question that the object is achieved. It fills a need which is great indeed.

The chapters are well arranged and each is complete in itself, which makes the publication so much more useful for the purposes of reference.

The bibliography at the end of each chapter shows how much has in fact been written on the subject of dental health, but here again this book serves a great need by synthesizing the best from a multitude of separate articles.

The author points out the difficulties facing those who seek to enlist the aid of their non-dental colleagues. There is no bitterness at their lack of co-operation, but instead a factual, experienced line of approach which any who sincerely wish to promote dental health, through education, would be well advised to read and remember.

The book is no doubt primarily written for those dental health educators who work in the American primary, grade, and high schools, but the lessons that have been learned there can well be applied in Great Britain.

The author is engaged in teaching others how to teach dental health and is obviously proud to be doing so; she is also clear in her own mind that dental health is an asset to be sought after by both young and old and obviously feels privileged to have the knowledge with which to help them gain this benefit. I am sure her feeling of pride and privilege is fully justified.

The book should be read by all engaged in the Public Dental Services and it would benefit the whole profession to read it, too. It is full of fact and simple common sense.

A. M.

CLEFT LIP AND PALATE. By W. G. HOLDSWORTH, F.R.C.S. (Eng.), Surgeon, Rooksdown House, Basingstoke, with a foreword by Sir HAROLD GILLIES, C.B.E., F.R.C.S. Second edition, 10 × 7¾ in. Pp. 187 + xii, with 146 illustrations. 1957. London: William Heinemann. 42s.

THE treatments of congenital deformities of lip and palate are of interest to the dental surgeon and this, the second edition of a well-known work originally published in 1951, sets out the principles and various treatments clearly and concisely. The inclusion of chapters on

"Development" by Professor R. J. Harrison and "Orthodontic Treatment" by M. A. Kettle is a step in the right direction. The "group approach" has already developed in parts of America where the specialists are consulted *before* surgical treatment is planned. Future editions might, therefore, be further improved by the inclusion of chapters by a speech therapist, a prosthetist, and even a psychiatrist.

Non-surgical closure of cleft palates is only mentioned, so the great advantages of the little known McNeil technique over all surgical techniques do not receive the attention they deserve.

The lay-out is good, the illustrations well chosen, and with the author's flowing style make an easy book to read and follow; it can be recommended to all interested in the subject.

H. E. W.

LOCAL ANÆSTHESIA AND PAIN CONTROL IN DENTAL PRACTICE. By LEONARD M. MONHEIM, B.S., M.S., D.D.S., Professor and Head of Department of Anæsthesia, University of Pittsburgh School of Dentistry; Assistant Professor, Department of Surgery, (Anæsthesia), University of Pittsburgh School of Medicine. $9\frac{1}{4} \times 6\frac{1}{8}$ in. Pp. 299, with 128 illustrations. 1957. London: Henry Kimpton. 65s.

HERE is an honest and sincere approach to all facets of local dental anæsthesia, with all its modern theories and laws, applied with the common sense of a clinician.

The book commences with the usual anatomical sketches and descriptions. The drawings are poor, and at this phase, it should not be necessary to re-learn in written detail the anatomy of the nerve distributions. A few clear and concise diagrams would be better for revision.

The types and techniques of anæsthesia are very adequately portrayed, but slightly marred by the confusion over the differentiation of analgesia and anæsthesia.

Although this is an American publication, nearly all the anæsthetics and drugs discussed are now available and used in Great Britain. The author, stressing the importance of reading the current literature on new drugs, gives a short list of references on published material.

There are excellent chapters on pre-anæsthetic evaluation, anæsthetic complications and emergencies, and post-operative control of pain, written in such a conversational vein it seems that one is present at the incident. These chapters can be re-read, and on each occasion there is knowledge assimilated which can be of immense clinical value.

Under "Equipment" there is described an aspirating cartridge which has obvious advantages, particularly for use by the general medical practitioner.

A small chapter covers, in very general terms, physical and chemical sterilization, followed by a final chapter "Medico-legal Aspects", which is naturally related to American law, but the mistakes and corrections are still the same whatever the country, and emphasize that it is far better to seek the consultation of a specialist for the sake of the patient and the practitioner.

In all, this is a book not only for the student but for the dental practitioner. It is easy to read and re-emphasizes many points given by our lecturers that may have slipped into oblivion.

J. L. M.

CALCIUM METABOLISM. By J. T. IRVING, M.A., Ph.D., M.D., F. Odont. Soc. S.A., Professor of Experimental Odontology; Director of the Joint Dental Research Unit of the Council for Scientific and Industrial Research, and of the University of the Witwatersrand, Johannesburg. $6\frac{3}{4} \times 4\frac{1}{4}$ in. Pp. 177 + xii. 1957. London: Methuen & Co. Ltd. 11s. 6d.

THIS is indeed an excellent monograph on calcium metabolism, and the author deserves the highest praise for the lucid manner in which he has handled this difficult subject. There are fifteen chapters, each dealing with a certain facet of the subject, such as Intestinal Absorption or Enzymes and Bone Formation. Full references are given to the literature, making this book of great value to the

advanced student and research worker alike. It will be to the physiologist and biochemist that this book will have the greatest appeal, but to all workers in the study of bone and teeth this book can be strongly recommended. In this age of inflation it is a pleasure to find such an authoritative book selling for such a reasonable price. B. E. G. C.

ABSTRACTS FROM OTHER JOURNALS

Repositioning and Increasing the Zone of Attached Gingiva

An operation is described in which a flap of gingival tissue is reflected and made to re-attach itself at a more apical level, thereby deepening the vestibule. This is produced by pressing the flap against bone until bleeding ceases and the fibrin of the clot maintains the flap in the desired position. Adhesive tin-foil is then moulded over the area and a periodontal pack applied over this.

Serial photographs are produced showing how new gingival tissue is formed over the exposed bone and the author justifies the procedure of leaving bone uncovered by soft tissue on the grounds that maxillo-facial surgeons often leave considerable exposed areas in cleft palate operations.—ARIAUDO, A. A., and TYRRELL, H. A. (1957), *J. Periodont.*, **28**, 106.

The Effects of Vertical Occlusal Trauma on the Periodontium of Protein-deprived Young Adult Rats

Eighty-two male rats weighing, on average, 290 grammes were divided into two groups, one of which was placed on a diet deficient in protein, but identical in all other respects with that of the other group.

In half the animals of each group an amalgam filling was placed in the maxillary first and second molars on one side, so that it had a flat top level with the highest cusp. The animals were sacrificed after a 6- or 12-week experimental period.

It was found that those with occlusal derangement produced a disorganization and degeneration of the periodontal fibres, thrombosis of the vessels, and a lack of repair in the periodontal tissues of the protein-deficient animals. Those subjected to the occlusal trauma, but on a normal diet, showed less severe degenerative changes and evidence of active repair. No changes in the position of the epithelial attachment were observed in any of the groups, except where there was gingival irritation from food impaction or broken crowns.

Restoration of a normal diet, after the six weeks of protein deprivation, revealed repair of the periodontal membrane and replacement of bone in those animals which had been on a protein-deficient diet only, but it did not permit restoration of normal tissue morphology in the animals whose tissues have been subject to occlusal trauma.—STAHL, S. S., MILLER, S. C., and GOLDSMITH, E. D. (1957), *J. Periodont.*, **28**, 87.

Some Factors Determining the Evaluation of Forces in Orthodontics

In histological observations it was found that during the intial stage of a tipping tooth movement performed with continuous forces, a cell-free compressed area is frequently created on the pressure side, even when the force applied is light. This compressed area is eliminated by indirect bone resorption after a period varying from 2 to 4 weeks and occasionally longer.

Compressed cell-free areas were observed less frequently when bodily movement was produced.

Considerable variation in the amount of pressure needed to produce these compressed areas was found, and it varied according to the type of movement produced.

It is recommended that a force of only 25 grammes should be used in the movement of extrusion of individual anterior teeth, but that as much as 250 grammes might be applied during final stage of continuous bodily movement of canines.—REITAN, K. (1957), *Amer. J. Orthodont.*, **43**, 32.